PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-126103

(43)Date of publication of application : 11.05.2001

(51)Int.Cl. G07D 5/02
G07D 5/08

(21)Application number : 11-324623

(22)Date of filing : 15.11.1999

(71)Applicant : JAPAN TOBACCO INC

(72)Inventor : LARRY J HOUSE
RICHARD J DAVIS

(30)Priority

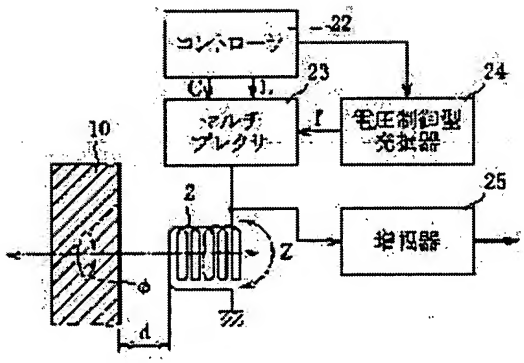
Priority number : 1999 422801 Priority date : 22.10.1999 Priority country : US

(54) DEVICE FOR IDENTIFYING COIN

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a coin identifying device capable of easily identifying the type and truth/falsehood of a coin with high accuracy by paying attention to recessed/projecting information made by a punched pattern on the coin surface.

SOLUTION: This device applies a high frequency electromagnetic field to the coin 10 by using an eddy current coil 2, measures the impedance of each eddy current coil which is changed by being affected by an eddy current generated by the high frequency electromagnetic field in the coin and obtains the recessed/projecting design of the punched design on the coin surface. The device also applies a low frequency electromagnetic field to the coin by using the eddy current coil, measures the impedance of the eddy current coil which is changed by being affected by an eddy current generated by the low frequency electromagnetic field in the coin and obtains information about the coin material. The device identifies the type and truth/falsehood of the coin according to these information (the impedances of the eddy current coil).



LEGAL STATUS

[Date of request for examination] 27.12.1999

[Date of sending the examiner's decision of rejection] 09.07.2002

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention makes an eddy current occur for coin using two or more eddy current coils, and relates to the coin identification unit which investigates the punching pattern in a coin front face, the construction material of coin, etc., and judges the classification and truth of this coin from the impedance of each above-mentioned eddy current coil which changes with these eddy currents.
[0002]
[A related background technique] The coin identification unit which judges the classification of coin and its truth is built into an automatic vending machine or an automatic money processing machine (ATM) as a pre-treatment equipment when calculating the charge amount of money. This kind of coin identification unit is constituted so that the outer diameter and its thickness of coin, and weight may be measured, and that truth may be chiefly judged by comparing with the outer diameter of the coin (two or more sorts of coin made into a handling object) of normal currently called for beforehand, thickness, and weight, respectively to be the classification of coin and it may reject about a counterfeit coin.
[0003] However, it is dealt with, there is coin besides an object, for example, the coin of a foreign country, and a possibility similar to the descriptions (an outer diameter, thickness, weight, etc.) of the coin of the normal made into a handling object of incorrect-recognizing this is in many coin.
[0004]
[Problem(s) to be Solved by the Invention] Then, to detect as an image the concavo-convex information which the punching pattern in a coin front face makes, to carry out recognition processing of the description of this image, and to identify that classification is tried. However, it may be difficult for the dust and dirt adhering to a coin front face to become a cause, and to detect the description of the punching pattern on the front face of coin itself with a sufficient precision. Furthermore, when comparing the description of the image which the punching pattern on the front face of coin makes with the description of the image shown according to the punching pattern of the coin of the normal made into a handling object, after carrying out revolution processing of the processing-object image, matching processing is carried out, or processing of performing the Fourier transform is needed suitably. There is nonconformity referred to as the processing which discernment of this reason and coin takes being complicated, and requiring the great processing time.
[0005] This invention was made in consideration of such a situation, and the object is in offering the coin identification unit which can identify the classification and truth with a sufficient precision simple moreover paying attention to the concavo-convex information which the punching pattern in a coin front face makes.
[0006]
[Means for Solving the Problem] When this invention adds a field to coin using an eddy current coil, it notes that the eddy current produced for coin by this field changes with construction material, thickness, etc. of this coin, and the impedance of this eddy current coil changes in response to the effect of this eddy current, in order to solve the problem mentioned above.
[0007] Then, continuing throughout coin using an eddy current coil, and adding a high-frequency field locally one by one so that it may indicate to claim 1, so that the coin identification unit concerning this invention may simplify classification of coin, and its truth and may identify them to high degree of accuracy The impedance of said eddy current coil which changes with these high-frequency fields in response to the effect of the eddy current produced for coin is measured. Acquire the concavo-convex information on the punching pattern in a coin front face, and, on the other hand, a low frequency field is added to coin using said eddy current coil. The impedance of said eddy current coil

which changes with these low frequency fields in response to the effect of the eddy current produced for coin is measured, the information about the construction material of coin is acquired, and it is characterized by identifying coin according to such information.

[0008] That is, the coin identification unit simplifies the class and truth of coin and it enabled it to identify to high degree of accuracy by acquiring the information about the construction material of coin from the impedance of the eddy current coil when this invention acquiring the concavo-convex information on the punching pattern in a coin front face from the impedance of each eddy current coil when carrying out RF actuation of two or more eddy current coils, and carrying out low frequency actuation of the specific eddy current coil is offered.

[0009] RF actuation of two or more eddy current coils by which two-dimensional array is carried out and opposite arrangement is more specifically carried out on a coin front face is carried out, and low frequency actuation of said eddy current coil is carried out, and the impedance of said eddy current coil which changes in response to the effect of the eddy current produced for said coin synchronizing with actuation of these eddy current coils is detected. And the impedance of said eddy current coil when carrying out low frequency actuation of said eddy current coil is compared with the above-mentioned impedance currently beforehand called for about the coin of normal, and the construction material of this coin is judged. Moreover, it asks as description information showing the concavo-convex information on a punching pattern [in / for the impedance of each eddy current coil when carrying out RF actuation of said eddy current coil / a coin front face], this description information is compared with the description information on the coin of normal currently called for beforehand, and the classification of coin is identified. It is characterized by creating as description information showing the concavo-convex information on a punching pattern [in / for the histogram which shows especially distribution of an impedance / a coin front face], comparing this histogram with the above-mentioned histogram of the coin of normal currently called for beforehand, and identifying the classification of coin.

[0010] The desirable mode of this invention is realized as a coil array which makes a predetermined geometric array as a coil array which said two or more eddy current coils made the rectangle-like grid on the flat surface, and was arranged. Moreover, said RF driving means carries out RF actuation of all the eddy current coils that constitute said coil array at order, and scans the whole region of coin, and said low frequency driving means is constituted so that low frequency actuation only of the specific eddy current coil in said coil array may be carried out. For example, the specific eddy current coil by which low frequency actuation is carried out is set up as an eddy current coil of the predetermined number arranged in the abbreviation center section in two or more eddy current coils which make a coil array. In addition, said coil array which put in order and prepared the coil array in the flank of two or more eddy current coils, or prepared in piles the eddy current coil by which low frequency actuation is carried out is good also as an eddy current coil of the independent dedication.

[0011] Moreover, the coin identification unit concerning this invention is equipped with a diameter measurement means of coin to measure the diameter of coin, and consists of impedances of each eddy current coil when carrying out RF actuation of said eddy current coil further. Furthermore, it has a coin thickness measurement means to measure the thickness of coin, and consists of impedances of each eddy current coil when carrying out RF actuation of said eddy current coil. Moreover, the coin identification unit concerning this invention is equipped with an image-processing means to regard the concavo-convex information on the punching pattern in a coil front face as two-dimensional or a three-dimension image, and consists of impedances of each eddy current coil when carrying out RF actuation of said eddy current coil.

[0012] In addition, an eddy current coil is driven on the frequency of 10kHz - about 100kHz, and it is constituted so that low frequency electromagnetic field may be generated, so that it drives an eddy current coil on the frequency of 700kHz - about 1MHz, it is constituted so that RF electromagnetic field may be generated so that said RF driving means may occur an eddy current near the front face of coin, and said low frequency driving means may occur an eddy current inside coin.

[0013] It realizes as a voltage-controlled oscillator with which adjustable control of the oscillation frequency is carried out by the control voltage applied from the outside, and said RF driving means and a low frequency driving means change the frequency which drives an eddy current coil by changing the above-mentioned control voltage, and, specifically, function as a RF driving means or low frequency driving means. Moreover, through a multiplexer, alternatively in response to the fact that the output from a voltage-controlled oscillator, oscillation actuation of two or more eddy current coils concerning this invention is carried out, and the above-mentioned multiplexer is constituted so that the eddy current coil which carries out oscillation actuation may be scanned at a high speed.

[0014] In addition, it is also possible to prepare the eddy current coil by which low frequency actuation is carried out apart from two or more eddy current coils by which RF actuation is carried out. Moreover, it is desirable to add the low frequency electromagnetic field which it faced [electromagnetic field] to carry out low frequency actuation of the

eddy current coil, and to investigate the construction material of coin, and said eddy current coil was selectively driven [electromagnetic field], for example on two or more sorts of frequencies of about 100kHz, or changed the drive frequency of said eddy current coil continuously in the 100kHz - about 700kHz frequency range, and made it generate by this to two or more parts of coin.

[0015]

[Embodiment of the Invention] Hereafter, the coin identification unit applied to the operation gestalt of this invention with reference to a drawing is explained. Drawing 1 (a) shows the outline configuration of the coil array 1 included in the coin identification unit concerning this operation gestalt. This coil array 1 makes the lattice (matrix array) of the shape of a rectangle of a m line xn train on a flat surface, and the eddy current coil 2 of plurality (mxn individual) is constituted. The coil array 1 specifically than the outer diameter of the coin made into a handling object [larger] For example, a curled form flat-surface coil with an outer diameter [as shown at drawing 2 on the 30mmx insulating substrate 3 predetermined / with a magnitude of about 50mm] of 2mm - about 5mm is used as the eddy current coil 2. It realizes as a printed circuit board which formed two or more flat-surface coils (eddy current coil 2) by the predetermined array pitches Px and Py (for example, about 6mm).

[0016] Common connection of lead terminal 2a of the couple of each of these eddy current coils 2 and the 2b is made for every line and train, respectively, and they are drawn as lead terminal 4a for line selection in the coil array 1, and lead terminal 4b for train selection. One of the lead terminal 4a for these line selections is specified, and one of the lead terminal 4b for train selection is specified simultaneously, and by energizing between these lead terminal 4a and 4b, one eddy current coil 2 in the coil array 1 is specified alternatively, and it drives.

[0017] In addition, two or more eddy current coils 2 which constitute the coil array 1 are used in order to impress a high-frequency field locally to coin so that it may mention later. Moreover, four eddy current coil 2x arranged, specific eddy current coil 2, for example, abbreviation center section, in two or more eddy current coils 2 by which the matrix array was carried out, are used also in order to impress a low frequency field to coin.

[0018] Energization actuation is carried out by the alternating current of a predetermined frequency, and the eddy current coil 2 (2x) generates a field (a high-frequency field or low frequency field), and bears the role which occurs the eddy current according to that construction material, thickness, etc. for this coin by impressing this field (alternating current field) to coin locally. And the eddy current coil 2 (2x) bears the role which functions as the sensor section for detecting change of the impedance as a description of coin using the eddy current produced for coin acting on the eddy current coil 2 (2x), and resulting in change to the impedance of this eddy current coil 2 (2x) so that it may mention later.

[0019] The coil array 1 equipped with such two or more eddy current coils 2 is arranged along with the guide 11 which forms the path of coin 10, as the outline configuration of the sensing section in a coin identification unit is shown in drawing 3 - drawing 5 . The front view in which drawing 3's having fractured a part of sensing section, and having shown the internal structure incidentally, the top view where drawing 4 looked at the sensing section from the upper part, and drawing 5 are the side elevations which looked at the sensing section from [of coin 10] migration.

[0020] That is, on both sides of the guide 11 which forms the path of coin 10, the sensing section forms two coil arrays 1 in parallel, and is constituted. These coil arrays 1 are arranged so that face to face may be stood against parallel, respectively at the table rear face of the coin 10 which moves in the array side of the eddy current coil 2 while it is led by the guide 11 and rolling. Especially the coil array 1 is set up so that the effect of the eddy current which the respectively minute gap was separated, contiguity arrangement was carried out, and the generating field of the eddy current coil 2 acted on the table rear face in which the punching pattern of the shape of irregularity of coin 10 was formed in a coil 10 sufficiently strongly, and was produced for coin 10 may act in the eddy current coil 2 concerned sufficiently strongly.

[0021] In addition, although the example which prepares the sensing section in the path to which it is made to move, rolling coin 10 here is shown, it is also possible to prepare the sensing section in the path to which it is made to move, sideslipping coin 10, and the drop path of coin 10. Moreover, of course, it is also possible to use the forming face of the eddy current coil 2 in the coil array 1 by the protective coat as some guides 11 which form the path of coin for a bonnet and this coil array 1 very thing.

[0022] By the way, it is also possible to realize as eddy current coil 2y of dedication which put in order and prepared the eddy current coil for impressing a low frequency field to coin 10 in the coil array 1 as shown in drawing 1 (b) independently [two or more eddy current coils 2 by which make the coil array 1, are prepared and RF actuation is carried out]. moreover -- or it is also possible to realize the eddy current coil for impressing a low frequency field as eddy current coil 2y of the dedication prepared in the coil array 1 in piles. In this case, as eddy current coil 2y for low frequency actuation, it is desirable to consider as the thing of the major diameter of path extent of coin 10. Moreover,

what is necessary is just to arrange these eddy current coils 2, 2x, and 2y along the [redacted] so that face to face may be stood against coin 10, respectively as shown in drawing 6 (a) and (b), respectively.

[0023] Now, roughly, the coin identification unit which drives each eddy current coil 2 of the coil array 1 mentioned above, detects the description of coin 10, and identifies the classification of this coin 10 is constituted, as shown in drawing 7 . This coin identification unit operates a controller 22 under control of a microprocessor 21, it drives each eddy current coil 2 of the coil array 1 so that it may explain below, and it detects the description of coin 10 as an impedance of each eddy current coil 2 which changes with these coin 10. And it is constituted so that the classification of coin 10 and its truth may be judged according to the impedance of each detected eddy current coil 2.

[0024] That is, while a controller 22 drives a multiplexer 23 and chooses two or more eddy current coils 2 of the coil array 1 in order, this eddy current coil 2 is driven by adding the alternating current of the predetermined frequency outputted to the selected eddy current coil 2 from the voltage-controlled oscillator (VCO) 24. According to the clock signal CLK of the predetermined periodicity emitted from a controller 22, a multiplexer 23 chooses one like a sequential patrol of lead terminal 4b for train selection of the coil array 1, and impresses the output (alternating current) of the voltage-controlled oscillator 24 for every train to two or more eddy current coils 2.

[0025] Simultaneously, a multiplexer 23 changes lead terminal 4a for line selection to ground one by one, whenever selection of lead terminal 4b for the above-mentioned train selection takes a round, while grounding selectively [lead terminal 4a for line selection of the coil array 1 / one]. One of two or more of the eddy current coils 2 in which the matrix array was carried out by the line of the coil array 1 by such multiplexer 23 and selection actuation of a train is chosen in order, and energization actuation is carried out with the voltage-controlled oscillator 24. That is, energization actuation of two or more eddy current coils 2 is scanned two-dimensional according to the array.

[0026] Moreover, the electrical potential difference between terminals of the eddy current coil 2 in which energization actuation is chosen and carried out by the multiplexer 23 (the amplitude or its phase) is detected through amplifier 25 as an output (alternating voltage) from the voltage-controlled oscillator 24 selectively added to lead terminal 4b for train selection of the coil array 1. This amplifier 25 bears the role which detects change of the impedance of the eddy current coil 2 as change of the amplitude of the signal (output of the voltage-controlled oscillator 24) which drives this eddy current coil 2, or a phase. And synchronizing with the timing of the multiplexer 23 by said controller 22 of operation, the amplitude / phase detector 26 samples the output of amplifier 25 synchronizing with selection actuation of the eddy current coil 2, detects the amplitude and phase, and presents the data collection by the microprocessor 21, and its storage with them.

[0027] Incidentally, when coin 10 is led to the sensing section mentioned above, a controller 22 controls actuation of a multiplexer 23 to carry out energization actuation of all the eddy current coils 2 of the coil array 1 first at order, in response to the fact that the command from a microprocessor 21. under the present circumstances, the controller 22 -- the voltage-controlled oscillator 24 -- receiving -- the 1st control voltage -- impressing -- this voltage-controlled oscillator 24 -- the frequency of 700kHz or more -- oscillation actuation is preferably carried out on the frequency of about 1MHz. RF actuation of all the eddy current coils 2 is carried out one by one by this on the frequency which is about 1MHz.

[0028] And when RF actuation of all the eddy current coils 2 is completed, a controller 22 controls actuation of a multiplexer 23 to carry out sequential energization actuation only of the specific eddy current coil 2x mentioned above shortly. And at this time, a controller 22 impresses the 2nd control voltage to the voltage-controlled oscillator 24, and carries out oscillation actuation of this voltage-controlled oscillator 24 on the frequency of 100kHz - about 700kHz. Low frequency actuation only of the specific eddy current coil 2x is carried out one by one by this on the frequency which is 100kHz - about 700kHz. Therefore, the voltage-controlled oscillator 24 collaborates with a controller 22, and functions selectively as the RF driving means which carries out RF actuation of the eddy current coil 2, and a low frequency driving means which carries out low frequency actuation of the eddy current coil 2.

[0029] in addition, the time of specific eddy current coil 2x mentioned above being chosen in the process which is carrying out RF actuation while choosing the eddy current coil 2 in order -- this -- synchronizing -- actuation of the voltage-controlled oscillator 24 -- controlling -- this -- it may be made to carry out low frequency actuation of eddy current coil 2x. That is, low frequency actuation of the specific eddy current coil 2x is carried out, other eddy current coils 2 are beforehand set up so that RF actuation may be carried out, and you may make it complete the scan covering the whole region of the coil array 1 by driving only once two or more eddy current coils 2 (2x) which the coil array 1 has one by one.

[0030] Thus, the oscillation amplitude of each eddy current coil 2 (2x) when carrying out energization actuation of each eddy current coil 2 (2x) is detected in order through amplifier 25, and the amplitude/phase detector 26 as information which shows the impedance of the eddy current coil 2 (2x) which changed with coin 10, changing

actuation conditions. That is, amplifier 25 is used as an impedance measurement means against the eddy current coil 2 (2x).

[0031] The impedance of the eddy current coil 2 (2x) which changes with coin 10 here is explained. Drawing 8 undergoes the output from the voltage-controlled oscillator 24, and shows typically the relation between one eddy current coil 2 by which energization actuation is selectively carried out under actuation of a multiplexer 23, and the coin 10 to which alternating current electromagnetic field are locally added with this eddy current coil 2. If the alternating current electromagnetic field phi which the eddy current coil 2 generated are added to coin 10, an eddy current Ic will occur to the part which the alternating current electromagnetic field of coin 10 cross. The magnitude of this eddy current Ic changes with the construction material and thickness (resistivity) of coin 10. Moreover, the magnetic flux which this eddy current Ic generates acts so that the alternating current magnetic flux which the eddy current coil 2 generates may be negated. Since the magnetic flux which the eddy current coil 2 generates substantially will be reduced even if the current which drives the eddy current coil 2 is fixed for this reason, the inductance Z of this eddy current coil 2, i.e., an impedance, will decrease.

[0032] If it puts in another way, and an alternating current field will be added to coin 10 from the eddy current coil 2 and an eddy current will be occurred for this coin 10, the impedance of the eddy current coil 2 will fall in response to the effect of this eddy current. And the effect the magnetic flux which an eddy current Ic generates affects the eddy current coil 2 acts so strongly that the distance d of the eddy current coil 2 and the front face of coin 10 is short, and its lowering of the impedance of the eddy current coil 2 is large.

[0033] Amplifier 25 is regarding change of such an impedance of the eddy current coil 2 as change of the amplitude of the signal which drives the eddy current coil 2, and detects the impedance of this eddy current coil 2. Since it is dependent on change of the distance d with the irregularity by the punching pattern of the front face of not only the construction material of coin 10 but the coin 10, as a result the eddy current coil 2, the impedance of the eddy current coil 2 which changes in response to the effect of the eddy current produced especially for the coin 10 becomes possible [extracting the description of coin 10] by detecting this impedance.

[0034] An eddy current occurs to the field near the front face of coin 10, and if the frequency of alternating current electromagnetic field becomes low at reverse, a field will permeate the interior of coin 10 and it will become easy to generate an eddy current in the interior, so that the frequency of the alternating current electromagnetic field which the eddy current coil 2 incidentally generates is high. Therefore, what is necessary is just to make it drive the eddy current coil 2 in an about 1MHz RF so that an eddy current may be occurred on the front face of the coin 10 which has the concavo-convex side which makes a punching pattern, in detecting the information on concavo-convex that the punching pattern on the front face of a coil is made. Thus, if an eddy current Ic is occurred on the front face of coin 10, with the distance d with the eddy current coil 2 which changes with the irregularity of the front face of coin 10, the effect of the above-mentioned eddy current Ic will act on the eddy current coil 2 greatly, and will change the impedance of this eddy current coil 2 a lot. Consequently, it becomes possible from change of the impedance of the eddy current coil 2 to detect effectively the irregularity which the punching pattern of the front face of coin 10 makes.

[0035] Conversely, what is necessary is just to make it set up the drive frequency of the eddy current coil 2 low with 10kHz - about 100kHz, in detecting the information on the construction material of coin 10 in order to generate an eddy current in the interior of coin 10 so that an eddy current Ic may change with the construction material a lot. Thus, only the effect of the magnitude of the eddy current Ic generated inside coin 10 will attain to the eddy current coil 2, without being influenced [most] by the distance d with the eddy current coil 2 by the irregularity of the front face of change, if the interior of coin 10 is made to generate an eddy current Ic. And since the magnitude of the eddy current Ic generated inside coin 10 is greatly influenced by the construction material of coin 10, it becomes possible [acquiring the information about the construction material of coin 10] from change of the impedance of the eddy current coil 2. The actuation conditions (drive frequency) of the eddy current coil 2 which controls actuation of the voltage-controlled oscillator 24 and is set up as mentioned above are defined based on such knowledge.

[0036] Next, the coin discernment processing performed by the microprocessor 21 is explained. Drawing 9 shows an example of the rough procedure of a microprocessor 21. This processing is started from detecting the input of coin 10 using the various coin detection sensors (not shown) built into a coin path [step S1]. If the input of coin 10 made applicable to discernment is detected, a microprocessor 21 starts a controller 22, with [step S2] which operates the voltage-controlled oscillator 24 with high frequency first, will control actuation of a multiplexer 23 and will carry out RF actuation of all the eddy current coils 2 of the coil array 1 at order [step S3]. And the amplitude / phase detector 26 is driven synchronizing with RF actuation of these eddy current coils 2, sequential detection is carried out and sample hold of the impedance of the eddy current coil 2 measured through amplifier 25 is carried out [step S4]. Thus, sequential storing is carried out at the internal memory (not shown) with which the microprocessor 21 was equipped,

and detection processing of the concavo-convex information on the front face of the coin 10 by RF actuation of two or more eddy current coils 2 ends the impedance of each measured eddy current coil 2 by [step S5] and this.
[0037] Then, a microprocessor 21 carries out RF actuation only of the eddy current coil 2x as which actuation of a multiplexer 23 was controlled and it was specified in the coil array 1 with [step S6] which operates the voltage-controlled oscillator 24 by low frequency first at order [step S7]. And the amplitude / phase detector 26 is driven synchronizing with these low frequency actuation of eddy current coil 2x, sequential detection of the impedance of the eddy current coil 2 measured through amplifier 25 is carried out, and sample hold of this is carried out [step S8]. thus, it was measured -- each -- [step S9] which carries out sequential storing also with the impedance of eddy current coil 2x at the internal memory (not shown) with which the microprocessor 21 was equipped. Detection processing of the information about the construction material of the coin 10 by low frequency actuation of the eddy current coil 2 is completed by the above processing.
[0038] After an appropriate time, a microprocessor 21 starts discernment processing of coin 10 as the internal processing according to the impedance of each eddy current coil 2 (2x) stored in memory as mentioned above. It discriminates from the impedance of each eddy current coil 2 by which RF actuation was carried out first with a predetermined threshold, and this discernment processing investigates the array location for example, on the coil array 1 of the eddy current coil 2 without change of an impedance, and this eddy current coil 2 [step S10]. And from the positional information of the eddy current coil 2 without impedance change, in quest of the eddy current coil 2 which stood face to face against coin 10 at the time of impedance measurement, the outline (overall magnitude) of this coin 10 is investigated conversely, and the overall diameter is measured as an outer diameter of coin 10 [step S11]. And according to this outer diameter, the microprocessor 21 is prepared beforehand, for example, the classification candidate of coin 10 is selected with reference to a table as shown in drawing 10 [step S12].
[0039] namely, the outer diameter of two or more sorts of coin (coin of normal) made into a handling object (object for discernment) at a table and thick information -- the information on construction material (impedance of the eddy current coil which changes with construction material), the concavo-convex information on a punching pattern (information on an impedance that it changes with irregularity), etc. are further described as criteria data beforehand. The classification of the coin considered that this coin 10 corresponds by referring to such a table according to the outline (outer diameter) of the measured coin 10 is selected as the candidate. In addition, when the corresponding classification candidate is not found out, [step S13] and the coin 10 concerned are dealt with, and it rejects as not being the target coin (counterfeit coin) [step S14].
[0040] Now, if it carries out and the classification candidate to coin 10 is called for as mentioned above, the impedance of this eddy current coil 2 detected by carrying out low frequency actuation of the specific eddy current coil 2x mentioned above next will be read from memory, and matching processing of this impedance will be carried out with the information on an applicable classification candidate's construction material described by said table (impedance of the eddy current coil which changes with construction material) [step S15]. In this case, it asks for four specified total of each impedance of eddy current coil 2x, or the average of each impedance as a measurement impedance, corresponding to how to ask for the impedance of the eddy current coil in which the information on the construction material of the coin 10 described by the table is shown, and this measurement impedance is compared with the impedance described by the table.
[0041] And the classification candidate who chose on the basis of the outer diameter of coin 10 by matching processing of this impedance as mentioned above judges whether consistency can be taken also in respect of that construction material [step S16]. In addition, that consistency is not found out in matching processing of this impedance, but in the construction material of coin 10 dealing with it and differing from the construction material of the target coin, it rejects this as a counterfeit coin [step S14].
[0042] In the matching processing about the construction material mentioned above, if consistency with a classification candidate is checked, discernment processing based on the concavo-convex information which the punching pattern of the front face of coin 10 makes next will be performed. This processing reads the impedance of each eddy current coil 2 called for when RF actuation of two or more eddy current coils 2 is carried out, and it is started from creating that histogram [step S17]. This histogram is created by carrying out counting of a partition opium poppy and the number of the eddy current coils 2 which have the impedance of that magnitude for every level to two or more level which set up the impedance of each eddy current coil 2 beforehand according to that magnitude. And distribution of an impedance is expressed with creating the histogram which sets an axis of abscissa as the impedance divided on two or more level, and sets an axis of ordinate as the number of the eddy current coils 2.
[0043] The impedance of each eddy current coil 2 called for when RF actuation of the eddy current coil 2 is incidentally carried out changes with the distance d of the concavo-convex side and the eddy current coil 2 in the front

face of coin 10, as mentioned above. And the irregularity of the front face of coin 1[illegible]hows the punching pattern of coin 10. This reason and the impedance divided by two or more level as mentioned above show extent of the irregularity of the difference in the above-mentioned distance d, as a result the front face of coin 10. Therefore, the histogram mentioned above shows the distribution situation of surface irregularity that the punching pattern of coin 10 was formed.

[0044] Matching processing of such a histogram is carried out with the histogram of the irregularity information (histogram of the impedance which changes with irregularity) of the punching pattern of the target coin [deal with it and] beforehand registered into the table, and the classification candidate called for as especially mentioned above, and the consistency of the punching pattern of coin 10 is judged by [step S18] and this [step S19].

[0045] Even if the punching pattern of coin 10 that classification incidentally differs is alike, the condition of the irregularity which the punching pattern generally makes changes greatly with classification of coin, and there is a big difference also in the distribution situation of the irregularity in the surface whole region of coin 10. When a hole is put on and altered into the front face in order to adjust especially the weight of coin 10 and the punching pattern of coin 10 itself is transformed greatly, a concavo-convex distribution situation changes substantially.

[0046] That is, even if it is two kinds of coin in which the outer diameter and the punching pattern are alike, as shown, for example in drawing 11 , as compared with the distribution (histogram A) of the irregularity on the front face of coin made into a handling object, distribution (histogram B) of the irregularity on the front face of coin of the outside for handling has a remarkable difference in the peak location and width of face of a flare, deflection, etc. Therefore, if the histogram which shows concavo-convex distribution is compared, it will become possible to judge effectively the condition of the irregularity which the punching pattern formed in the front face of coin 10 makes, i.e., the description of a punching pattern.

[0047] Then, when the consistency of the concavo-convex information which a punching pattern shows is checked by such matching processing of a histogram, the candidate classification called for as mentioned above is decided noting that it is the classification of the coin 10 concerned [step S20]. Moreover, the coin 10 is rejected noting that the punching pattern is un-exact (i.e., ****** [it differs from the thing of the coin made into a handling object]), when matching of a histogram goes wrong [step S14].

[0048] In addition, about matching processing of the punching pattern of the front face of the coin 10 by the histogram of the impedance mentioned above, it is desirable to perform to each punching pattern of the front face of coin 10 and a rear face, respectively about the information (impedance) detected to both sides (table rear face) of coin 10 by two coil arrays 1 by which opposite arrangement was carried out, respectively, respectively.

[0049] It does in this way. As change of the impedance of the eddy current coil 2 (2x) According to the coin identification unit which detects the construction material of coin 10, the outer diameter of coin 10, and the concavo-convex information that the punching pattern of the front face makes further, and judges the classification of coin 10, and its truth according to such information The discernment can be performed with a simply and sufficient precision, without being influenced by the dust and dirt adhering to a coin front face unlike what detects the information on the front face of coin 10 optically. And since the impedance of this eddy current coil 2 (2x) that changes in response to the effect of the eddy current produced for coin 10 by the alternating current field added from the eddy current coil 2 (2x) itself is detected as description information on coin 10, it is not necessary to prepare separately the coil for alternating current field generating, and the coil for sensing, and the configuration of the sensing section is dramatically easy. Therefore, since what is necessary is just to form two coil arrays 1 in both sides of coin 10, respectively even if it faces [detecting, respectively] the concavo-convex information which the punching pattern on the rear face of a table of coin 10 makes, the configuration is easy.

[0050] Moreover, an eddy current is made to occur in the surface section of coin 10 by carrying out RF actuation of the eddy current coil 2. Concavo-convex information is detected from change of the impedance of the eddy current coil 2 at that time. Moreover, since an eddy current is made to occur inside coin 10 by carrying out low frequency actuation of eddy current coil 2x and the information about the construction material of coin 10 is acquired from change of the impedance of eddy current coil 2x at that time For example, the description of the property in which coin 10 differs is effectively detectable, respectively only by changing the actuation conditions of the eddy current coil 2 (2x).

[0051] Furthermore, it detected as change of the impedance of the eddy current coil 2 in which the irregularity which the punching pattern of the front face of coin 10 makes is shown, the axis of abscissa was set as the impedance value for the histogram which shows distribution of this impedance, and the description of the punching pattern which the irregularity of the front face of coin 10 makes is caught by creating the number of the eddy current coils 2 which acquired each impedance value as an axis of ordinate. And since matching processing of this histogram is carried out, the discernment (collating) based on the description of the punching pattern of the front face of coin 10 is easy, and,

moreover, can make that discernment precision high enough. Moreover, since complicated processing of rotating the information which shows a punching pattern by using such a histogram, and arranging the direction of a pattern becomes unnecessary, there is an advantage -- large simplification of discernment processing and shortening of a processing duration can be attained.

[0052] In addition, this invention is not limited to the operation gestalt mentioned above. As the eddy current coil 2 is shown in drawing 5 , from the concavo-convex information on the front face of the coin 10 called for by carrying out RF actuation For example, the table rear face of coin 10, The both sides are asked for the average clearance dave1 and dave2 with two coil arrays 1 (eddy current coil 2) by which opposite arrangement was carried out, respectively. Thickness t of coin 10 is measured as (t=D-dave1-dave2) from the opposite distance D between these coil arrays 1, comparison collating of this thickness t is carried out with the thickness information on the coin registered into the table, and you may make it assist discernment processing of coin.

[0053] Moreover, although the information on the punching pattern of coin 10 was regarded as a histogram of the impedance which shows irregularity and being used for discernment processing, in an operation gestalt, the detection location is regarded as a two-dimensional image image developed as plane coordinates, and it may be made to make into brightness information concavo-convex information (impedance) in each part of the coin 10 which a punching pattern forms, and to carry out discernment processing. Or it is also possible to make into distance (height) with the eddy current coil 2 concavo-convex information (impedance) in each part of the coin 10 which a punching pattern forms, to regard the detection location as three-dimension-data developed as plane coordinates, and to use for discernment processing.

[0054] Furthermore, it is also possible to constitute so that low frequency actuation of eddy current coil 2x is carried out, and it faces to acquire the information about the construction material of coin 10, and change that drive frequency gradually in a predetermined frequency range (for example, 10kHz - 700kHz), or may make it change continuously in a predetermined frequency range, that impedance may be measured for every frequency, the change pattern depending on the frequency of this impedance may be caught and the construction material of coin 10 may be judged. In this case, in case low frequency actuation of eddy current coil 2x is carried out, what is necessary is just made to carry out adjustable control of the oscillation frequency of the electrical-potential-difference adjustable mold oscillator 24 under control of a controller 22.

[0055] Moreover, what is necessary is just not to set according to the number of the eddy current coils 2 incorporated as a coil array 1, its array pitch, and the specification of the coin which makes the array pattern etc. a handling object further, and in short, in the range which does not deviate from the summary, this invention can deform variously and can be carried out.

[0056]

[Effect of the Invention] Since the information about the construction material of coin is acquired from the impedance of the eddy current coil when according to this invention carrying out RF actuation of the eddy current coil, adding a high-frequency field to coin, acquiring the concavo-convex information on the punching pattern in a coin front face from the impedance of each eddy current coil at that time, as explained above, and carrying out low frequency actuation of the specific eddy current coil and the class and truth of coin are identified, it can simplify and coin can be identified to high degree of accuracy. The coin identification unit which can identify the classification and truth of coin to high degree of accuracy can be offered without being influenced of dust, dirt, etc. adhering to this reason and a coin front face.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Two or more eddy current coils by which two-dimensional array is carried out and opposite arrangement is carried out on a coin front face, The RF driving means which carries out RF actuation of these eddy current coils, adds a high-frequency field to said coin locally, and occurs an eddy current, The low frequency driving means which carries out low frequency actuation of said eddy current coil, adds a low frequency field to said coin, and occurs an eddy current, An impedance measurement means to detect the impedance which originates in the eddy current produced for this coin of the eddy current coil which added the field, and changes to said coin, The impedance of this eddy current coil when carrying out low frequency actuation of said eddy current coil, A construction material judging means to compare the certified value of the above-mentioned impedance currently beforehand called for about the coin of normal, and to judge the construction material of this coin, A feature-extraction means to search for the concavo-convex information on the punching pattern in a coin front face from the impedance of each eddy current coil when carrying out RF actuation of said eddy current coil, The coin identification unit characterized by providing a pattern [that compare the concavo-convex information on the punching pattern searched for with this feature-extraction means with the concavo-convex information on the punching pattern of the coin of normal currently called for beforehand, and the classification of coin is identified] judging means.
[Claim 2] Said feature-extraction means is a coin identification unit according to claim 1 characterized by consisting of a histogram creation means create as description information to express the concavo-convex information on a punching pattern [in / for the histogram which shows distribution of an impedance to this impedance of each eddy current coil when carrying out RF actuation of said eddy current coil / a coin front face].
[Claim 3] It is the coin identification unit according to claim 1 which said two or more eddy current coils make a rectangle-like grid on a flat surface, or make a predetermined geometric array, and form a coil array, and said RF driving means carries out RF actuation of all the eddy current coils that constitute said coil array at order, scans the whole region of coin, and is characterized by said low frequency driving means carrying out low frequency actuation only of the specific eddy current coil in said coil array.
[Claim 4] Said eddy current coil of the specification by which low frequency actuation is carried out is a coin identification unit according to claim 3 characterized by consisting of an eddy current coil of the predetermined number arranged in the abbreviation center section in two or more eddy current coils which make a coil array.
[Claim 5] Said two or more eddy current coils are coin identification units according to claim 1 characterized by consisting of two or more eddy current coils by which form a coil array, are prepared and RF actuation is carried out, and an eddy current coil by which arranges to the flank of this coil array, is prepared, and low frequency actuation is carried out.
[Claim 6] Said two or more eddy current coils are coin identification units according to claim 1 characterized by consisting of two or more eddy current coils by which form a coil array, are prepared and RF actuation is carried out, and an eddy current coil by which is prepared in this coil array in piles, and low frequency actuation is carried out.
[Claim 7] The coin identification unit characterized by having a diameter measurement means of coin to be a coin identification unit according to claim 1, and to measure the diameter of coin from the impedance of each eddy current coil when carrying out RF actuation of said eddy current coil further.
[Claim 8] The coin identification unit characterized by having a coin thickness measurement means to be a coin identification unit according to claim 1, and to measure the thickness of coin from the impedance of each eddy current coil when carrying out RF actuation of said eddy current coil further.
[Claim 9] The coin identification unit which is a coin identification unit according to claim 1, and is characterized by having an image-processing means to regard the concavo-convex information on the punching pattern in a coil front face as two-dimensional or a three-dimension image from the impedance of each eddy current coil when carrying out

RF actuation of said eddy current coil furt[redacted].

[Claim 10] It is the coin identification unit according to claim 1 which said RF driving means drives said eddy current coil on the frequency of 700kHz - about 1MHz, makes generate RF electromagnetic field, and is characterized by for said low frequency driving means driving said eddy current coil on the frequency of 10kHz - about 100kHz, and generating low frequency electromagnetic field.

[Claim 11] Said RF driving means and a low frequency driving means are a coin identification unit according to claim 1 characterized by consisting of a voltage-controlled oscillator with which adjustable control of the oscillation frequency is carried out by the control voltage applied from the outside, changing the frequency which drives an eddy current coil by changing the above-mentioned control voltage, and functioning as a RF driving means or a low frequency driving means.

[Claim 12] It is the coin identification unit according to claim 1 which oscillation actuation of said two or more eddy current coils is carried out through a multiplexer alternatively in response to the fact that the output from a voltage-controlled oscillator, and is characterized by the above-mentioned multiplexer scanning the eddy current coil which applies the output of a voltage-controlled oscillator at a high speed.

[Claim 13] Said eddy current coil by which low frequency actuation is carried out is a coin identification unit according to claim 1 characterized by being prepared apart from two or more eddy current coils by which RF actuation is carried out.

[Claim 14] Said low frequency driving means is a coin identification unit according to claim 1 characterized by generating the low frequency electromagnetic field which said eddy current coil is selectively driven on two or more sorts of frequencies of about 100kHz, or the drive frequency of said eddy current coil is changed continuously in an about 100kHz frequency range, and are added to two or more parts of coin.

[Claim 15] Said two or more eddy current coils are coin identification units according to claim 1 characterized by carrying out a matrix array on a flat surface, and carrying out opposite arrangement of the coil array at nothing and the table rear face of coin, respectively.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the outline configuration of the coil array included in the coin identification unit concerning 1 operation gestalt of this invention, and the array configuration of the coil array and the eddy current coil for low frequency actuation which are built into a coin identification unit.
[Drawing 2] Drawing showing the configuration of the flat-surface coil (eddy current coil) which constitutes the coil array shown in drawing 1 .
[Drawing 3] The front view in which having fractured a part of sensing section in the coin identification unit concerning one example of this invention, and having shown the internal structure.
[Drawing 4] The top view which looked at the sensing section from the upper part.
[Drawing 5] The side elevation which looked at the sensing section from [of coin] migration.
[Drawing 6] Drawing showing the example of arrangement over the coin of the eddy current coil in another operation gestalt of this invention.
[Drawing 7] The overall outline block diagram of the coin identification unit concerning 1 operation gestalt of this invention.
[Drawing 8] Drawing showing typically the relation between the eddy current coil in a coin identification unit, and the coin to which an alternating current field is locally added with this eddy current coil.
[Drawing 9] Drawing showing an example of the rough procedure of the coin discernment processing performed in a microprocessor.
[Drawing 10] Drawing showing the example of the table which stored the information on the coin used for coin discernment processing.
[Drawing 11] Drawing showing the example of the histogram showing distribution of the irregularity which the punching pattern of coin makes of an impedance.
[Description of Notations]
1 Coil Array
2 Eddy Current Coil
10 Coin
21 Microprocessor
22 Controller
23 Multiplexer
24 Voltage-controlled Oscillator (RF Driving Means / Low Frequency Driving Means)
25 Amplifier (Impedance Measurement Means)
26 Amplitude/Phase Detector

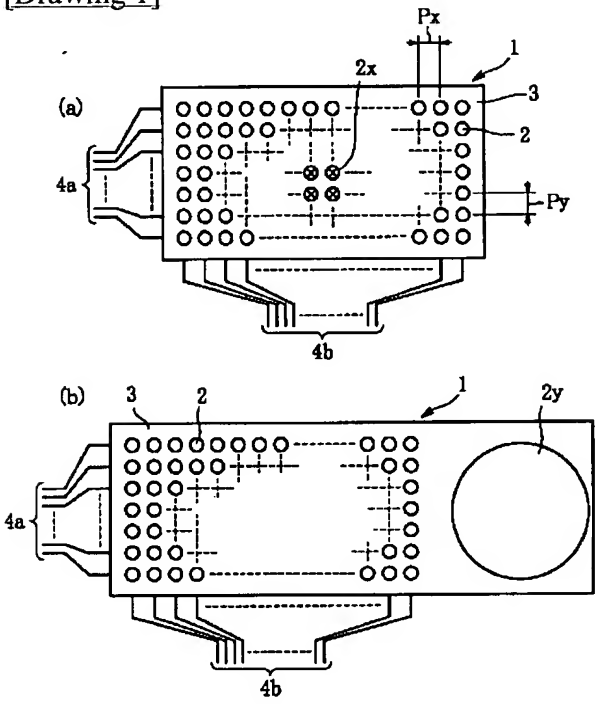
[Translation done.]

* NOTICES *

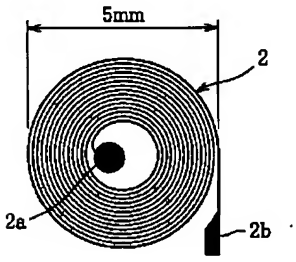
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

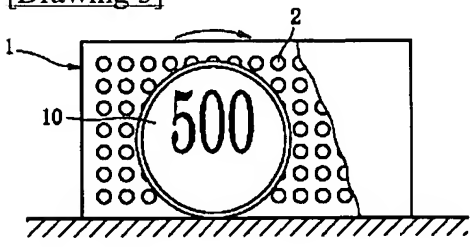
[Drawing 1]



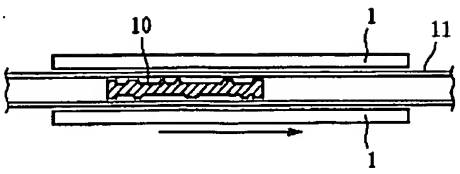
[Drawing 2]



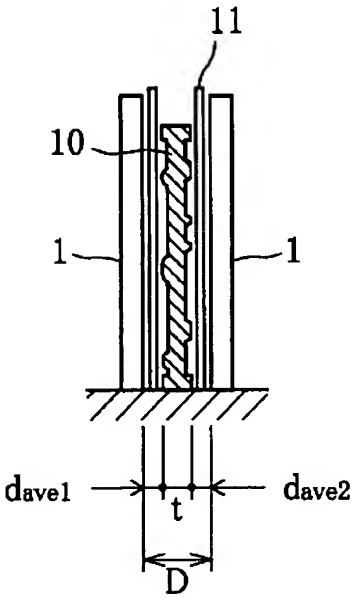
[Drawing 3]



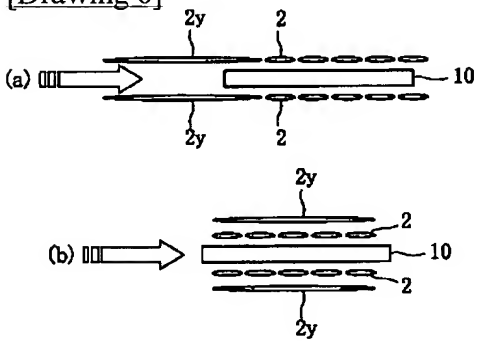
[Drawing 4]



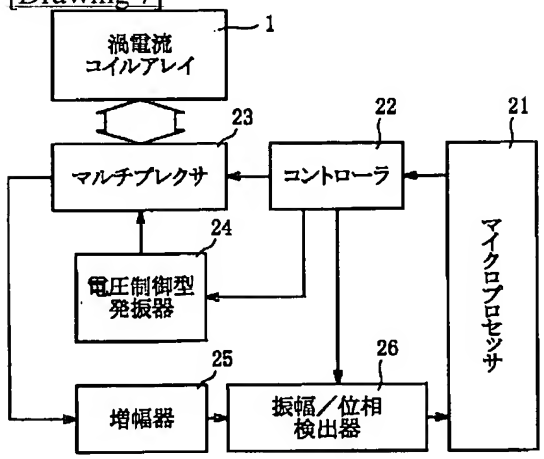
[Drawing 5]



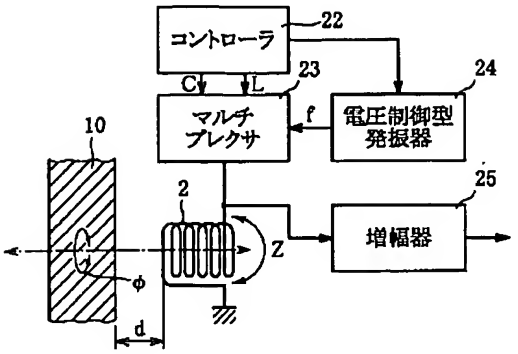
[Drawing 6]



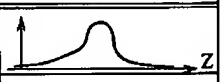
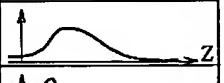
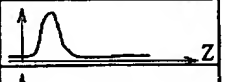
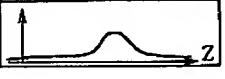
[Drawing 7]



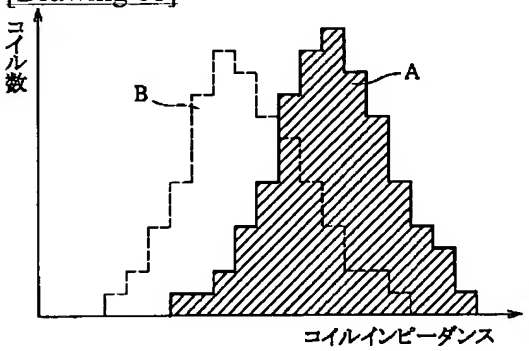
[Drawing 8]



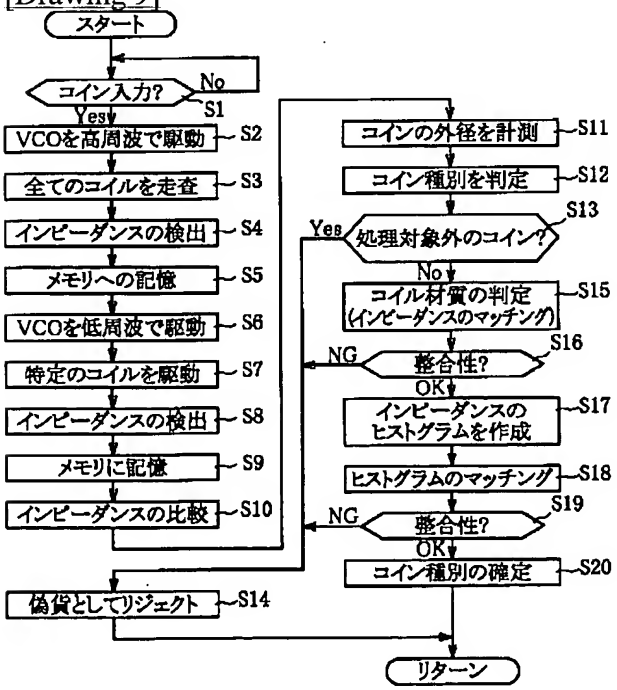
[Drawing 10]

種別	外径	材質 (インピーダンス)	肉厚	模様の凹凸情報 (ヒストグラム)
500YEN	27mmφ	Z_{500}	1.80mm	
100YEN	22mmφ	Z_{100}	1.70mm	
50YEN	20mmφ	Z_{50}	1.75mm	
10YEN	23mmφ	Z_{10}	1.50mm	

[Drawing 11]



[Drawing 9]



(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－126103
（P2001－126103A）
(43)公開日　平成13年5月11日(2001.5.11)

(51)Int.Cl.'		識別記号	FI			テーマコード'(参考)
G07D	5/02	104	G07D	5/02	104	3E002
	5/08	103		5/08	103	

審査請求　有　請求項の数15　ＯＬ　（全 11 頁）

(21)出願番号　特願平11－324623

(22)出願日　平成11年11月15日(1999.11.15)

(31)優先権主張番号　09／422801

(32)優先日　平成11年10月22日(1999.10.22)

(33)優先権主張国　米国（ＵＳ）

(71)出願人　000004569
日本たばこ産業株式会社
東京都港区虎ノ門二丁目２番１号

(72)発明者　ラリィー　ジェイ．ハウス
アメリカ合衆国　43201－2693　オハイオ州　コロンバス　キング　アベニュー　505　バテル記念研究所内

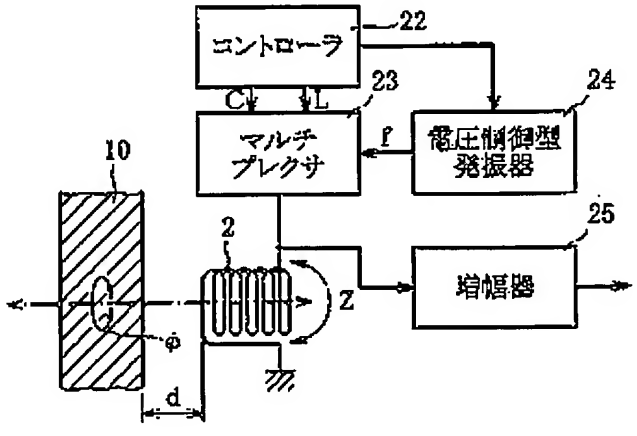
(72)発明者　リチャード　ジェイ．デイビス
アメリカ合衆国　43201－2693　オハイオ州　コロンバス　キング　アベニュー　505　バテル記念研究所内

(74)代理人　100090022
弁理士　長門　侃二

最終頁に続く

(54)【発明の名称】　コイン識別装置

(57)【要約】
【課題】　コイン表面における打抜模様がなす凹凸情報に着目して、その種別や真偽を簡易に精度良く識別することのできるコイン識別装置を提供する。
【解決手段】　渦電流コイル２を用いてコイン１０に高周波電磁界を加え、この高周波電磁界によってコインに生じる渦電流の影響を受けて変化する当該渦電流コイルのインピーダンスを計測して、コイン表面における打抜模様の凹凸情報を得る。また渦電流コイルを用いてコインに低周波電磁界を加え、この低周波電磁界によってコインに生じる渦電流の影響を受けて変化する渦電流コイルのインピーダンスを計測して、コインの材質に関する情報を得る。そしてこれらの情報（渦電流コイルのインピ



1

【特許請求の範囲】

【請求項１】　２次元配列されてコイン表面に対向配置される複数の渦電流コイルと、

これらの渦電流コイルを高周波駆動し、前記コインに局所的に高周波磁界を加えて渦電流を生起する高周波駆動手段と、

前記渦電流コイルを低周波駆動し、前記コインに低周波磁界を加えて渦電流を生起する低周波駆動手段と、

前記コインに磁界を加えた渦電流コイルの、該コインに生じる渦電流に起因して変化するインピーダンスを検出するインピーダンス計測手段と、

前記渦電流コイルを低周波駆動したときの該渦電流コイルのインピーダンスと、正規のコインについて予め求められている上記インピーダンスの標準値とを比較して該コインの材質を判定する材質判定手段と、

前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスから、コイン表面における打抜模様の凹凸情報を求める特徴抽出手段と、

この特徴抽出手段にて求められた打抜模様の凹凸情報と、予め求められている正規のコインの打抜模様の凹凸情報とを比較してコインの種別を識別する模様判定手段とを具備したことを特徴とするコイン識別装置。

【請求項２】　前記特徴抽出手段は、前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスから、該インピーダンスの分布を示すヒストグラムを、コイン表面における打抜模様の凹凸情報を表す特徴情報として作成するヒストグラム作成手段からなることを特徴とする請求項１に記載のコイン識別装置。

【請求項３】　前記複数の渦電流コイルは、平面上に方形状の格子をなして或いは所定の幾何学的配列をなしてコイルアレイを形成し、

前記高周波駆動手段は、前記コイルアレイを構成する全ての渦電流コイルを順に高周波駆動してコインの全域を走査し、前記低周波駆動手段は前記コイルアレイ中の特定の渦電流コイルだけを低周波駆動することを特徴とする請求項１に記載のコイン識別装置。

【請求項４】　前記低周波駆動される特定の渦電流コイルは、コイルアレイをなす複数の渦電流コイル中の略中央部に配列された所定個数の渦電流コイルからなることを特徴とする請求項３に記載のコイン識別装置。

【請求項５】　前記複数の渦電流コイルは、コイルアレイを形成して設けられて高周波駆動される複数の渦電流コイルと、このコイルアレイの側部に並べて設けられて

2

【請求項７】　請求項１に記載のコイン識別装置であって、

更に前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスからコインの直径を計測するコイン径計測手段を備えることを特徴とするコイン識別装置。

【請求項８】　請求項１に記載のコイン識別装置であって、

更に前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスからコインの厚みを計測するコイン厚計測手段を備えることを特徴とするコイン識別装置。

【請求項９】　請求項１に記載のコイン識別装置であって、

更に前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスから、コイル表面における打抜模様の凹凸情報を２次元または３次元イメージとして捉えるイメージ処理手段を備えることを特徴とするコイン識別装置。

【請求項１０】　前記高周波駆動手段は、７００ｋＨｚ～１ＭＨｚ程度の周波数で前記渦電流コイルを駆動して高周波磁界を発生させ、前記低周波駆動手段は、１０ｋＨｚ～１００ｋＨｚ程度の周波数で前記渦電流コイルを駆動して低周波磁界を発生させることを特徴とする請求項１に記載のコイン識別装置。

【請求項１１】　前記高周波駆動手段および低周波駆動手段は、外部から加えられる制御電圧により発振周波数が可変制御される電圧制御型発振器からなり、

上記制御電圧を切り替えることにより渦電流コイルを駆動する周波数を切り替えて、高周波駆動手段または低周波駆動手段として機能することを特徴とする請求項１に記載のコイン識別装置。

【請求項１２】　前記複数の渦電流コイルは、マルチプレクサを介して電圧制御型発振器からの出力を択一的に受けて発振駆動され、

上記マルチプレクサは、電圧制御型発振器の出力を加える渦電流コイルを高速に走査することを特徴とする請求項１に記載のコイン識別装置。

【請求項１３】　前記低周波駆動される渦電流コイルは、高周波駆動される複数の渦電流コイルとは別に設けられることを特徴とする請求項１に記載のコイン識別装置。

【請求項１４】　前記低周波駆動手段は、１００ｋＨｚ

表裏面にそれぞれ対向配置されることを特徴とする請求項１に記載のコイン識別装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複数の渦電流コイルを用いてコインに渦電流を生起させ、この渦電流により変化する上記各渦電流コイルのインピーダンスから、コイン表面における打抜模様やコインの材質等を調べて該コインの種別や真偽を判定するコイン識別装置に関する。

【０００２】

【関連する背景技術】自動販売機や自動金銭処理機（ＡＴＭ）等には、投入金額を計算する上での前処理装置として、コインの種別やその真偽を判定するコイン識別装置が組み込まれる。この種のコイン識別装置は、専ら、コインの外径やその厚み、重さを計測し、予め求められている正規のコイン（取り扱い対象とする複数種のコイン）の外径、厚み、および重さとそれぞれ比較することでコインの種別とその真偽を判定し、また偽貨についてはリジェクトするように構成されている。

【０００３】しかし数多くのコインの中には、取り扱い対象とする正規のコインの特徴（外径、厚み、重さ等）に似た取り扱い対象外のコイン、例えば他国のコインがあり、これを誤認識する虞がある。

【０００４】

【発明が解決しようとする課題】そこでコイン表面における打抜模様がなす凹凸情報を画像として検出し、この画像の特徴を認識処理してその種別を識別することが試みられている。しかしコイン表面に付着した埃や汚れが原因となって、コイン表面の打抜模様の特徴自体を精度良く検出することが困難な場合がある。更にはコイン表面の打抜模様がなす画像の特徴を、取り扱い対象とする正規のコインの打抜模様によって示される画像の特徴と比較する場合、処理対象画像を回転処理した上でマッチング処理したり、適宜、フーリエ変換を施す等の処理が必要となる。これ故、コインの識別に要する処理が複雑であり、多大な処理時間を要すると言う不具合がある。

【０００５】本発明はこのような事情を考慮してなされたもので、その目的は、コイン表面における打抜模様がなす凹凸情報に着目して、その種別や真偽を簡易に、しかも精度良く識別することのできるコイン識別装置を提供することにある。

【０００６】

インの種別やその真偽を簡易にして高精度に識別するべく、請求項１に記載するように渦電流コイルを用いてコインの全域に亘って順次局所的に高周波磁界を加えながら、この高周波磁界によってコインに生じる渦電流の影響を受けて変化する前記渦電流コイルのインピーダンスを計測して、コイン表面における打抜模様の凹凸情報を得、一方、前記渦電流コイルを用いてコインに低周波磁界を加え、この低周波磁界によってコインに生じる渦電流の影響を受けて変化する前記渦電流コイルのインピーダンスを計測して、コインの材質に関する情報を得、これらの情報に従ってコインを識別するようにしたことを特徴としている。

【０００８】即ち、本発明は複数の渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスからコイン表面における打抜模様の凹凸情報を得、また特定の渦電流コイルを低周波駆動したときの渦電流コイルのインピーダンスからコインの材質に関する情報を得ることで、コインの種類や真偽を簡易にして高精度に識別し得るようにしたコイン識別装置を提供する。

【０００９】より具体的には、２次元配列されてコイン表面に対向配置される複数の渦電流コイルを高周波駆動し、また前記渦電流コイルを低周波駆動して、これらの渦電流コイルの駆動に同期して前記コインに生じる渦電流の影響を受けて変化する前記渦電流コイルのインピーダンスを検出する。そして前記渦電流コイルを低周波駆動したときの前記渦電流コイルのインピーダンスと、正規のコインについて予め求められている上記インピーダンスとを比較して該コインの材質を判定する。また前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスを、コイン表面における打抜模様の凹凸情報を表す特徴情報として求め、この特徴情報と予め求められている正規のコインの特徴情報とを比較してコインの種別を識別する。特にインピーダンスの分布を示すヒストグラムを、コイン表面における打抜模様の凹凸情報を表す特徴情報として作成し、このヒストグラムと予め求められている正規のコインの上記ヒストグラムとを比較してコインの種別を識別することを特徴としている。

【００１０】本発明の好ましい態様は、前記複数の渦電流コイルは、平面上に方形状の格子をなして配列されたコイルアレイとして、或いは所定の幾何学的配列をなすコイルアレイとして実現される。また前記高周波駆動手段は、前記コイルアレイを構成する全ての渦電流コイル

の側部に並べて設けた、或いは重ねて設けた前記コイルアレイとは独立した専用の渦電流コイルとしても良い。

【００１１】また本発明に係るコイン識別装置は、更に前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスからコインの直径を計測するコイン径計測手段を備えて構成される。更には前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスからコインの厚みを計測するコイン厚計測手段を備えて構成される。また本発明に係るコイン識別装置は、前記渦電流コイルを高周波駆動したときの各渦電流コイルのインピーダンスから、コイル表面における打抜模様の凹凸情報を２次元または３次元イメージとして捉えるイメージ処理手段を備えて構成される。

【００１２】尚、前記高周波駆動手段はコインの表面近傍に渦電流を生起するべく、例えば渦電流コイルを７００ｋＨｚ～１ＭＨｚ程度の周波数で駆動して高周波電磁界を発生させるように構成され、また前記低周波駆動手段はコインの内部に渦電流を生起するべく、例えば渦電流コイルを１０ｋＨｚ～１００ｋＨｚ程度の周波数で駆動して低周波電磁界を発生させるように構成される。

【００１３】具体的には前記高周波駆動手段および低周波駆動手段は、外部から与えられる制御電圧により発振周波数が可変制御される電圧制御型発振器として実現され、上記制御電圧を切り替えることにより渦電流コイルを駆動する周波数を切り替えて、高周波駆動手段または低周波駆動手段として機能する。また本発明に係る複数の渦電流コイルは、マルチプレクサを介して電圧制御型発振器からの出力を択一的に受けて発振駆動され、上記マルチプレクサは発振駆動する渦電流コイルを高速に走査するように構成される。

【００１４】尚、低周波駆動される渦電流コイルを、高周波駆動される複数の渦電流コイルとは別に設けることも可能である。また渦電流コイルを低周波駆動してコインの材質を調べるに際しては、例えば１００ｋＨｚ近傍の複数種の周波数で前記渦電流コイルを選択的に駆動して、或いは１００ｋＨｚ～７００ｋＨｚ程度の周波数範囲で前記渦電流コイルの駆動周波数を連続的に変化させ、これによって発生させた低周波電磁界をコインの複数の部位に加えることが望ましい。

【００１５】

【発明の実施の形態】以下、図面を参照して本発明の実施形態に係るコイン識別装置について説明する。図１（ａ）はこの実施形態に係るコイン識別装置に組み込まれ

き状の平面コイルを渦電流コイル２として、複数個の平面コイル（渦電流コイル２）を所定の配列ピッチＰｘ，Ｐｙ（例えば６ｍｍ程度）で形成したプリント回路基板として実現される。

【００１６】これらの各渦電流コイル２の一対のリード端子２ａ，２ｂは、行および列毎にそれぞれ共通接続されてコイルアレイ１における行選択用のリード端子４ａおよび列選択用のリード端子４ｂとして導出される。これらの行選択用のリード端子４ａの１つを指定し、同時に列選択用のリード端子４ｂの１つを指定して、これらのリード端子４ａ，４ｂ間を通電することで、コイルアレイ１中の１つの渦電流コイル２が択一的に指定されて駆動される。

【００１７】尚、コイルアレイ１を構成する複数の渦電流コイル２は、後述するようにコインに対して局部的に高周波磁界を印加する為に用いられる。またマトリックス配列された複数の渦電流コイル２中の特定の渦電流コイル２、例えば略中央部に配列された４つの渦電流コイル２ｘは、コインに対して低周波磁界を印加する為にも用いられる。

【００１８】渦電流コイル２（２ｘ）は、所定の周波数の交流電流により通電駆動されて磁界（高周波磁界または低周波磁界）を発生し、この磁界（交流磁界）をコインに局部的に印加することで該コインにその材質や厚み等に応じた渦電流を生起する役割を担う。そしてコインに生じた渦電流が、後述するように渦電流コイル２（２ｘ）に作用して該渦電流コイル２（２ｘ）のインピーダンスに変化をもたらすことを利用して、渦電流コイル２（２ｘ）はそのインピーダンスの変化をコインの特徴として検出する為のセンサ部として機能する役割を担う。

【００１９】このような複数の渦電流コイル２を備えたコイルアレイ１は、図３～図５にコイン識別装置におけるセンシング部の概略構成を示すように、コイン１０の通路を形成するガイド１１に沿って配置される。ちなみに図３はセンシング部の一部を破断してその内部構造を示した正面図、図４はセンシング部を上方から見た平面図、図５はセンシング部をコイン１０の移動方向から見た側面図である。

【００２０】即ち、センシング部は、コイン１０の通路を形成するガイド１１を挟んで２つのコイルアレイ１を平行に設けて構成される。これらのコイルアレイ１は、その渦電流コイル２の配列面を、ガイド１１に導かれて転動しながら移動するコイン１０の表裏面にそれぞれ平

移動させる通路にセンシング部を設ける例について示しているが、コイン１０を横滑りさせながら移動させる通路や、コイン１０の落下通路にセンシング部を設けることも可能である。またコイルアレイ１における渦電流コイル２の形成面を保護膜で覆い、このコイルアレイ１自体をコインの通路を形成するガイド１１の一部として用いることも勿論可能である。

【００２２】ところでコイン１０に対して低周波磁界を印加する為の渦電流コイルを、コイルアレイ１をなして設けられて高周波駆動される複数の渦電流コイル２とは別に、例えば図１(ｂ)に示すようにコイルアレイ１に並べて設けた専用の渦電流コイル２ｙとして実現することも可能である。また或いは低周波磁界を印加する為の渦電流コイルを、コイルアレイ１に重ねて設けた専用の渦電流コイル２ｙとして実現することも可能である。この場合、低周波駆動用の渦電流コイル２ｙとしては、コイン１０の径程度の大径のものとすることが好ましい。また図６(ａ)(ｂ)にそれぞれ示すように、これらの渦電流コイル２,２ｘ,２ｙをそれぞれコイン１０に対峙するように、その通路に沿って配置すれば良い。

【００２３】さて上述したコイルアレイ１の各渦電流コイル２を駆動してコイン１０の特徴を検出して該コイン１０の種別を識別するコイン識別装置は、概略的には図７に示すように構成される。このコイン識別装置は、マイクロプロセッサ２１の制御の下でコントローラ２２を作動させ、以下に説明するようにコイルアレイ１の各渦電流コイル２を駆動し、コイン１０の特徴を該コイン１０によって変化する各渦電流コイル２のインピーダンスとして検出する。そして検出した各渦電流コイル２のインピーダンスに従ってコイン１０の種別やその真偽を判定するように構成される。

【００２４】即ち、コントローラ２２はマルチプレクサ２３を駆動してコイルアレイ１の複数の渦電流コイル２を順に選択しながら、選択した渦電流コイル２に電圧制御型発振器（ＶＣＯ）２４から出力される所定周波数の交流電流を加えることで該渦電流コイル２を駆動する。マルチプレクサ２３は、例えばコントローラ２２から発せられる所定周期数のクロック信号ＣＬＫに従って、コイルアレイ１の列選択用のリード端子４ｂの１つを順次巡回的に選択して電圧制御型発振器２４の出力（交流電流）を複数の渦電流コイル２に対して列毎に印加する。

【００２５】同時にマルチプレクサ２３は、コイルアレイ１の行選択用のリード端子４ａの１つを選択的に接地して２次元的に走査される。

【００２６】またマルチプレクサ２３によって選択されて通電駆動される渦電流コイル２の端子間電圧（振幅またはその位相）は、例えばコイルアレイ１の列選択用のリード端子４ｂに選択的に加えられる電圧制御型発振器２４からの出力（交流電圧）として増幅器２５を介して検出される。この増幅器２５は、渦電流コイル２のインピーダンスの変化を、該渦電流コイル２を駆動する信号（電圧制御型発振器２４の出力）の振幅または位相の変化として検出する役割を担う。そして振幅／位相検出器２６は、前記コントローラ２２によるマルチプレクサ２３の動作タイミングに同期して、即ち、渦電流コイル２の選択動作に同期して増幅器２５の出力をサンプリングし、その振幅や位相を検出してマイクロプロセッサ２１によるデータ収集とその記憶に供する。

【００２７】ちなみにコントローラ２２は前述したセンシング部にコイン１０が導かれたとき、マイクロプロセッサ２１からの指令を受けて、例えば先ずコイルアレイ１の全ての渦電流コイル２を順に通電駆動するようにマルチプレクサ２３の作動を制御する。この際、コントローラ２２は電圧制御型発振器２４に対して第１の制御電圧を印加して、該電圧制御型発振器２４を７００ＫＨｚ以上の周波数、好ましくは１ＭＨｚ程度の周波数で発振動作させる。これによって全ての渦電流コイル２が１ＭＨｚ程度の周波数で順次高周波駆動される。

【００２８】そして全ての渦電流コイル２の高周波駆動が終了したときには、コントローラ２２は、今度は前述した特定の渦電流コイル２ｘだけを順次通電駆動するようにマルチプレクサ２３の作動を制御する。そしてこのとき、コントローラ２２は電圧制御型発振器２４に対して第２の制御電圧を印加して、該電圧制御型発振器２４を１００ｋＨｚ～７００ｋＨｚ程度の周波数で発振動作させる。これによって特定の渦電流コイル２ｘだけが１００ｋＨｚ～７００ｋＨｚ程度の周波数で順次低周波駆動される。従って電圧制御型発振器２４はコントローラ２２と協働して、渦電流コイル２を高周波駆動する高周波駆動手段、および渦電流コイル２を低周波駆動する低周波駆動手段として選択的に機能する。

【００２９】尚、渦電流コイル２を順に選択しながら高周波駆動している過程において、前述した特定の渦電流コイル２ｘが選択されたとき、これに同期して電圧制御型発振器２４の作動を制御して該渦電流コイル２ｘを低周波駆動するようにしても良い。つまり特定の渦電流コ

イル２（２ｘ）の発振振幅が、コイン１０によって変化した渦電流コイル２（２ｘ）のインピーダンスを示す情報として、増幅器２５および振幅／位相検出器２６を介して順に検出される。つまり増幅器２５は、渦電流コイル２（２ｘ）に対するインピーダンス計測手段として用いられている。

【００３１】ここでコイン１０によって変化する渦電流コイル２（２ｘ）のインピーダンスについて説明する。図８は高圧制御型発振器２４からの出力を受け、マルチプレクサ２３の作動の下で選択的に通電駆動される１つの渦電流コイル２と、この渦電流コイル２により局部的に交流磁界が加えられるコイン１０との関係を模式的に示している。渦電流コイル２が発生した交流電磁界φがコイン１０に加えられると、コイン１０の交流電磁界が横切る部位に渦電流Ｉｃが発生する。この渦電流Ｉｃの大きさはコイン１０の材質や厚み（抵抗率）によって変化する。またこの渦電流Ｉｃが発生する磁束は、渦電流コイル２が発生する交流磁束を打ち消すように作用する。この為、渦電流コイル２を駆動する電流が一定であっても、渦電流コイル２が実質的に発生する磁束が減らされることになるので、該渦電流コイル２のインダクタンス、つまりインピーダンスＺが減少することになる。

【００３２】換言すれば渦電流コイル２からコイン１０に交流磁界を加えて該コイン１０に渦電流を生起すると、この渦電流の影響を受けて渦電流コイル２のインピーダンスが低下する。しかも渦電流Ｉｃが発生する磁束が渦電流コイル２に及ぼす影響は、渦電流コイル２とコイン１０の表面との距離ｄが短い程強く作用し、渦電流コイル２のインピーダンスの低下が大きい。

【００３３】増幅器２５はこのような渦電流コイル２のインピーダンスの変化を、渦電流コイル２を駆動する信号の振幅の変化として捉えることで、該渦電流コイル２のインピーダンスを検出する。特にコイン１０に生じた渦電流の影響を受けて変化する渦電流コイル２のインピーダンスは、コイン１０の材質のみならず、コイン１０の表面の打抜模様による凹凸、ひいては渦電流コイル２との距離ｄの変化に依存するので、このインピーダンスを検出することによりコイン１０の特徴を抽出することが可能となる。

【００３４】ちなみに渦電流コイル２が発生する交流電磁界の周波数が高いほど、コイン１０の表面に近い領域に渦電流が発生し、逆に交流電磁界の周波数が低くなるとコイン１０の内部に磁界が浸透してその内部に渦電流

上記渦電流Ｉｃの影響が渦電流コイル２に大きく作用し、該渦電流コイル２のインピーダンスを大きく変化させる。この結果、渦電流コイル２のインピーダンスの変化から、コイン１０の表面の打抜模様がなす凹凸を効果的に検出することが可能となる。

【００３５】逆にコイン１０の材質の情報を検出する場合には、その材質によって渦電流Ｉｃが大きく変化するようにコイン１０の内部において渦電流を発生させるべく、例えば渦電流コイル２の駆動周波数を１０ｋＨｚ～１００ｋＨｚ程度と低く設定するようにすれば良い。このようにコイン１０の内部に渦電流Ｉｃを発生させれば、その表面の凹凸による渦電流コイル２との距離ｄの変化の影響を殆ど受けることなく、コイン１０の内部に発生した渦電流Ｉｃの大きさの影響だけが渦電流コイル２に及ぶことになる。しかもコイン１０の内部に発生する渦電流Ｉｃの大きさは、コイン１０の材質に大きく左右されるので、渦電流コイル２のインピーダンスの変化から、コイン１０の材質に関する情報を得ることが可能となる。前述した如く高圧制御型発振器２４の作動を制御して設定される渦電流コイル２の駆動条件（駆動周波数）は、このような知見に基づいて定められている。

【００３６】次にマイクロプロセッサ２１により実行されるコイン識別処理について説明する。図９はマイクロプロセッサ２１の概略的な処理手順の一例を示している。この処理は、コイン通路に組み込まれる種々のコイン検出センサ（図示せず）を用いてコイン１０の入力を検出することから開始される［ステップＳ１］。識別対象とするコイン１０の入力が検出されると、マイクロプロセッサ２１はコントローラ２２を起動し、先ず電圧制御型発振器２４を高周波数で作動させる［ステップＳ２］と共に、マルチプレクサ２３の作動を制御してコイルアレイ１の全ての渦電流コイル２を順に高周波駆動する［ステップＳ３］。そしてこれらの渦電流コイル２の高周波駆動に同期して振幅／位相検出器２６を駆動し、増幅器２５を介して計測される渦電流コイル２のインピーダンスを順次検出し、サンプル・ホールドする［ステップＳ４］。このようにして計測された各渦電流コイル２のインピーダンスは、マイクロプロセッサ２１が備えた内部メモリ（図示せず）に順次格納され［ステップＳ５］、これによって複数の渦電流コイル２の高周波駆動によるコイン１０の表面の凹凸情報の検出処理が終了する。

【００３７】その後、マイクロプロセッサ２１は、先ず

ンプル・ホールドする［ステップＳ８］。このようにして計測された各渦電流コイル２ｘのインピーダンスについても、マイクロプロセッサ２１が備えた内部メモリ（図示せず）に順次格納する［ステップＳ９］。以上の処理によって渦電流コイル２の低周波駆動によるコイン１０の材質に関する情報の検出処理が終了する。

【００３８】しかる後、マイクロプロセッサ２１はその内部処理として、前述した如くメモリに格納した各渦電流コイル２（２ｘ）のインピーダンスに従い、コイン１０の識別処理を開始する。この識別処理は、例えば先ず高周波駆動された各渦電流コイル２のインピーダンスを所定の閾値で弁別し、インピーダンスの変化のない渦電流コイル２と、該渦電流コイル２のコイルアレイ１上における配列位置とを調べる［ステップＳ１０］。そしてインピーダンス変化のない渦電流コイル２の位置情報から、逆にインピーダンス計測時にコイン１０に対時していた渦電流コイル２を求めて該コイン１０の外郭（全体的な大きさ）を調べ、その最大径をコイン１０の外径として計測する［ステップＳ１１］。そしてこの外径に従い、予めマイクロプロセッサ２１に準備されている、例えば図１０に示すようなテーブルを参照してコイン１０の種別候補を選定する［ステップＳ１２］。

【００３９】即ち、テーブルには、取り扱い対象（識別対象）とする複数種のコイン（正規のコイン）の外径や肉厚の情報、更には材質の情報（材質により変化する渦電流コイルのインピーダンス）、打抜模様の凹凸情報（凹凸によって変化するインピーダンスの情報）等が、予め基準データとして記述されている。このようなテーブルを参照することで、計測されたコイン１０の外郭（外径）に従って該コイン１０が該当すると考えられるコインの種別をその候補として選定する。尚、該当する種別候補が見出されなかった場合には［ステップＳ１３］、当該コイン１０を取り扱い対象とするコインでない（偽貨）としてリジェクトする［ステップＳ１４］。

【００４０】さて上述した如くしてコイン１０に対する種別候補が求められたならば、次に前述した特定の渦電流コイル２ｘを低周波駆動して検出された該渦電流コイル２のインピーダンスをメモリから読み出し、このインピーダンスを前記テーブルに記述されている該当種別候補の材質の情報（材質により変化する渦電流コイルのインピーダンス）とマッチング処理する［ステップＳ１５］。この場合、テーブルに記述されたコイン１０の材質の情報を示す渦電流コイルのインピーダンスの求め方

選択した種別候補が、その材質の点でも整合性がとれているか否かを判定する［ステップＳ１６］。尚、このインピーダンスのマッチング処理においてその整合性が見出されず、コイン１０の材質が取り扱い対象とするコインの材質と異なる場合には、これを偽貨としてリジェクトする［ステップＳ１４］。

【００４２】上述した材質についてのマッチング処理において、種別候補との整合性が確認されたならば、次にコイン１０の表面の打抜模様がなす凹凸情報に基づく識別処理を実行する。この処理は、複数の渦電流コイル２を高周波駆動した際に求められる各渦電流コイル２のインピーダンスを読み出し、そのヒストグラムを作成することから開始される［ステップＳ１７］。このヒストグラムは、各渦電流コイル２のインピーダンスを、その大きさに応じて予め設定した複数のレベルに区分けし、各レベル毎にその大きさのインピーダンスを有する渦電流コイル２の数を計数することによって作成される。そして複数のレベルに区画したインピーダンスを横軸とし、渦電流コイル２の数を縦軸とするヒストグラムを作成することで、インピーダンスの分布を表す。

【００４３】ちなみに渦電流コイル２を高周波駆動した際に求められる各渦電流コイル２のインピーダンスは、前述したようにコイン１０の表面における凹凸面と渦電流コイル２との距離ｄによって変化する。しかもコイン１０の表面の凹凸はコイン１０の打抜模様を示すものである。これ故、上述したように複数のレベルに区画されたインピーダンスは、上記距離ｄの違い、ひいてはコイン１０の表面の凹凸の程度を示す。従って上述したヒストグラムは、コイン１０の打抜模様が形成された表面の凹凸の分布状況を示すものとなる。

【００４４】このようなヒストグラムを、テーブルに予め登録された取り扱い対象とするコインの打抜模様の凹凸情報（凹凸によって変化するインピーダンスのヒストグラム）、特に前述した如く求められた種別候補のヒストグラムとマッチング処理し［ステップＳ１８］、これによってコイン１０の打抜模様の整合性を判定する［ステップＳ１９］。

【００４５】ちなみに種別の異なるコイン１０の打抜模様が似ていても、一般的にその打抜模様がなす凹凸の具合が、コインの種別によって大きく異なり、またコイン１０の表面全域における凹凸の分布状況にも大きな違いがある。特にコイン１０の重みを調整するべく、その表面に穴を穿いて変造したような場合、コイン１０の打抜

幅．偏差等において顕著な差異を持つ。従って凹凸の分布を示すヒストグラムを比較すれば．コイン１０の表面に形成された打抜模様がなす凹凸の状態、つまり打抜模様の特徴を効果的に判定することが可能となる。

【００４７】そこでこのようなヒストグラムのマッチング処理により．打抜模様が示す凹凸情報の整合性が確認されたとき、前述した如く求められた候補種別を．当該コイン１０の種別であるとして確定する［ステップＳ２０］。またヒストグラムのマッチングに失敗した場合には．その打抜模様が不明確であるとして、つまり取り扱い対象とするコインのものとは異なるとして、そのコイン１０をリジェクトする［ステップＳ１４］。

【００４８】尚．上述したインピーダンスのヒストグラムによるコイン１０の表面の打抜模様のマッチング処理については、コイン１０の両面（表裏面）にそれぞれ対向配置された２つのコイルアレイ１にてそれぞれ検出される情報（インピーダンス）について．コイン１０の表面および裏面の各打抜模様に対してそれぞれ実行することが好ましい。

【００４９】かくしてこのようにして渦電流コイル２（２ｘ）のインピーダンスの変化として、コイン１０の材質やコイン１０の外径．更にはその表面の打抜模様がなす凹凸情報を検出し、これらの情報に従ってコイン１０の種別やその真偽を判定するコイン識別装置によれば．光学的にコイン１０の表面の情報を検出するものと異なって、コイン表面に付着した埃や汚れに左右されることなく、簡易に、且つ精度良くその識別を行い得る。しかも渦電流コイル２（２ｘ）から加えた交流磁界によりコイン１０に生じる渦電流の影響を受けて変化する該渦電流コイル２（２ｘ）のインピーダンス自体を．コイン１０の特徴情報として検出するので．交流磁界発生用のコイルとセンシング用のコイルとを別個に設ける必要がなく、センシング部の構成が非常に簡単である。従ってコイン１０の表裏面の打抜模様がなす凹凸情報をそれぞれ検出するに際しても．２つのコイルアレイ１をコイン１０の両面にそれぞれ設けるだけで良いので．その構成が簡単である。

【００５０】また渦電流コイル２を高周波駆動することでコイン１０の表面部に渦電流を生起させ、そのときの渦電流コイル２のインピーダンスの変化から凹凸情報を検出し、また渦電流コイル２ｘを低周波駆動することでコイン１０の内部に渦電流を生起させ．そのときの渦電流コイル２ｘのインピーダンスの変化からコイン１０の

値を得た渦電流コイル２の数を縦軸として作成することで．コイン１０の表面の凹凸がなす打抜模様の特徴を捉えている。そしてこのヒストグラムをマッチング処理するので、コイン１０の表面の打抜模様の特徴に基づく識別（照合）が容易であり．しかもその識別精度を十分に高くし得る。またこのようなヒストグラムを用いることにより、打抜模様を示す情報を回転させて模様の方向を揃える等の煩雑な処理が不要となるので、識別処理の大幅な簡素化と．処理所要時間の短縮化を図ることとができる等の利点がある。

【００５２】尚．本発明は上述した実施形態に限定されるものではない。例えば渦電流コイル２を高周波駆動して求められるコイン１０の表面の凹凸情報から．図５に示すようにコイン１０の表裏面と、その両側に対向配置された２つのコイルアレイ１（渦電流コイル２）との平均的な離間距離ｄave1，ｄave2をそれぞれ求め、これらのコイルアレイ１間の対向距離Ｄとから（ｔ＝Ｄ－ｄave1－ｄave2）としてコイン１０の厚みｔを計測し．この厚みｔをテーブルに登録されているコインの厚み情報と比較照合して．コインの識別処理を補助するようにしても良い。

【００５３】また実施形態においては．コイン１０の打抜模様の情報を．凹凸を示すインピーダンスのヒストグラムとして捉えて識別処理に用いたが．打抜模様が形成するコイン１０の各部における凹凸情報（インピーダンス）を輝度情報とし、その検出位置を平面座標として展開した２次元画像イメージとして捉えて識別処理するようにしても良い。或いは打抜模様が形成するコイン１０の各部における凹凸情報（インピーダンス）を渦電流コイル２との距離（高さ）とし、その検出位置を平面座標として展開した３次元的データとして捉えて識別処理に用いることも可能である。

【００５４】更には渦電流コイル２ｘを低周波駆動してコイン１０の材質に関する情報を得るに際し、その駆動周波数を所定の周波数範囲（例えば１０ｋＨｚ～７００ｋＨｚ）において段階的に変えて．或いは所定の周波数範囲において連続的に変化させて各周波数毎にそのインピーダンスを計測し、このインピーダンスの周波数に依存する変化パターンを捉えてコイン１０の材質を判定するように構成することも可能である。この場合には、渦電流コイル２ｘを低周波駆動する際．コントローラ２２の制御の下で電圧可変型発振器２４の発振周波数を可変制御するようにすれば良い。

渦流コイルを高周波駆動してコインに高周波磁界を加え、そのときの各渦電流コイルのインピーダンスからコイン表面における打抜模様の凹凸情報を得、また特定の渦電流コイルを低周波駆動したときの渦電流コイルのインピーダンスからコインの材質に関する情報を得てコインの種類や真偽を識別するので、簡易にして高精度にコインを識別することができる。これ故、コイン表面に付着した埃や汚れ等の影響を受けることなく高精度にコインの種別や真偽を識別しうるコイン識別装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の一実施形態に係るコイン識別装置に組み込まれるコイルアレイの概略構成、およびコイン識別装置に組み込まれるコイルアレイと低周波駆動用の渦電流コイルとの配列構成を示す図。

【図２】図１に示すコイルアレイを構成する平面コイル（渦電流コイル）の構成を示す図。

【図３】本発明の一実施例に係るコイン識別装置におけるセンシング部の一部を破断してその内部構造を示した正面図。

【図４】センシング部を上方から見た平面図。

【図５】センシング部をコインの移動方向から見た側面図。

【図６】本発明の別の実施形態における渦電流コイルの＊

＊コインに対する配置例を示す図。

【図７】本発明の一実施形態に係るコイン識別装置の全体的な概略構成図。

【図８】コイン識別装置における渦電流コイルと、この渦電流コイルにより局部的に交流磁界が加えられるコインとの関係を模式的に示す図。

【図９】マイクロプロセッサにおいて実行されるコイン識別処理の概略的な処理手順の一例を示す図。

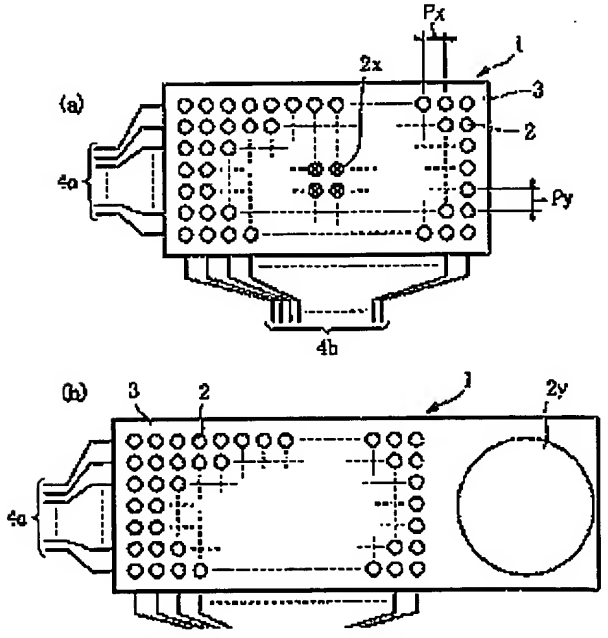
【図１０】コイン識別処理に用いられるコインの情報を格納したテーブルの例を示す図。

【図１１】コインの打抜模様がなす凹凸の分布を表すインピーダンスのヒストグラムの例を示す図。

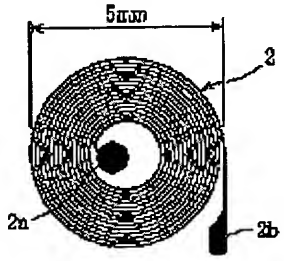
【符号の説明】

１　コイルアレイ
２　渦電流コイル
１０　コイン
２１　マイクロプロセッサ
２２　コントローラ
２３　マルチプレクサ
２４　電圧制御型発振器（高周波駆動手段／低周波駆動手段）
２５　増幅器（インピーダンス計測手段）
２６　振幅／位相検出器

【図１】



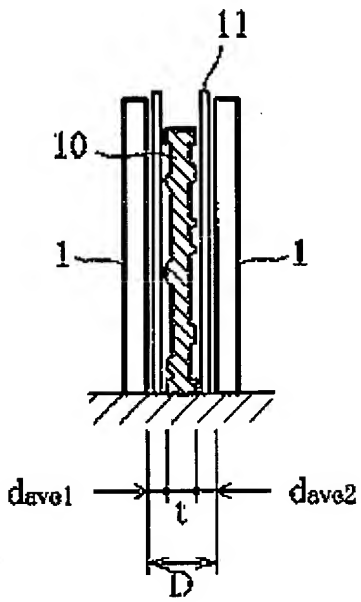
【図２】



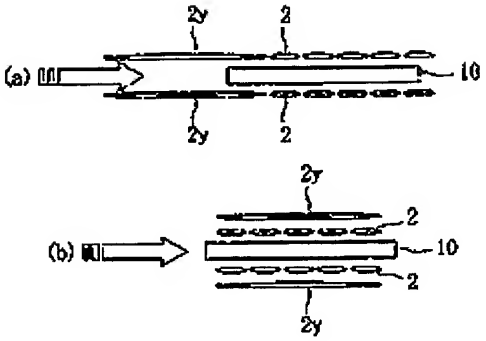
【図３】

【図４】

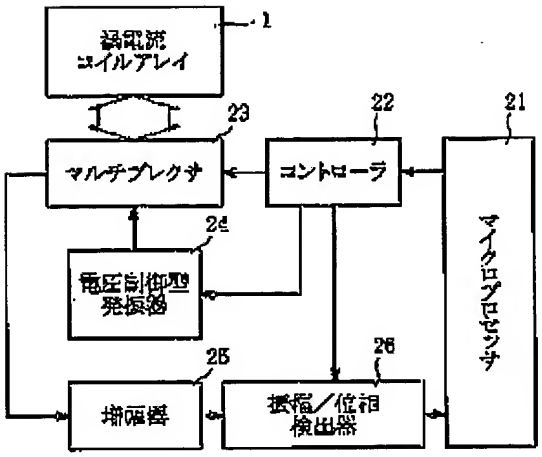
【図５】



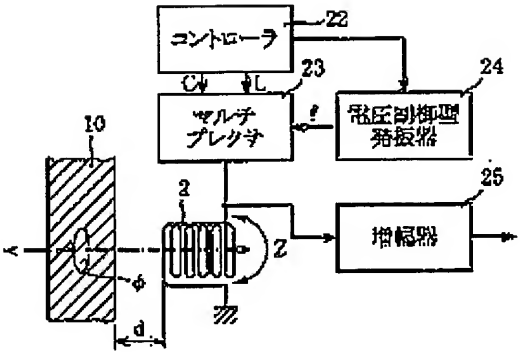
【図６】



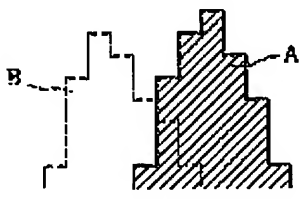
【図７】



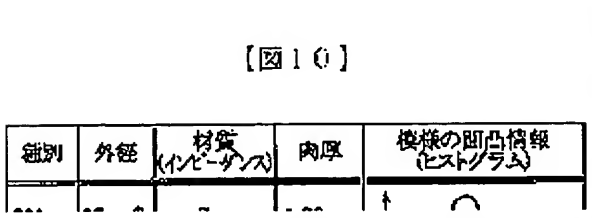
【図８】



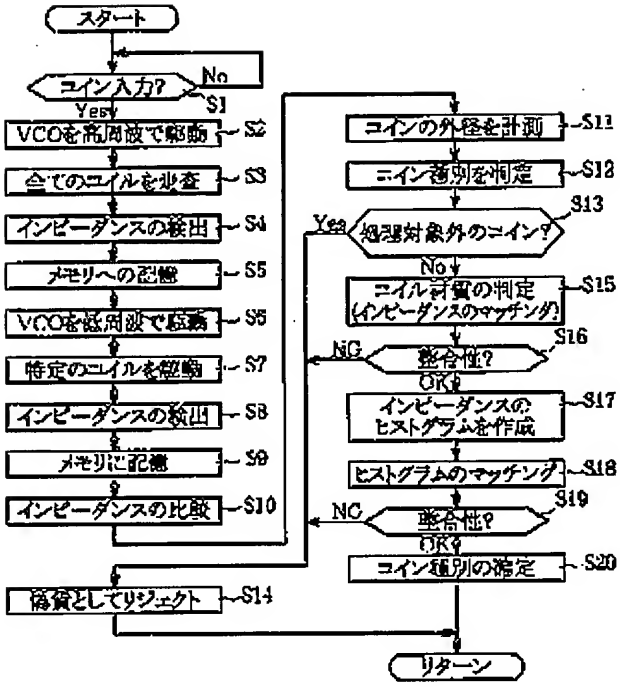
【図１１】



【図１０】



【図９】



フロントページの続き

Ｆターム(参考) 3E002 AA01 AA04 AA06 AA13 BC02
BC03 CA04 CA06 CA13 EA05